Chapter 3

Energy Efficiency and Conservation

Energy efficiency and conservation offer Virginia the most cost-effective and most readily deployable method to manage its energy future.

3.0 Energy Efficiency and Conservation

Energy efficiency and conservation offer Virginia the most cost-effective and most readily deployable method to manage its energy future. They should be the first actions consumers take to address future energy needs. Government also has a significant role to play to increase implementation of energy-efficiency and conservation measures by providing incentives, broadening public awareness, and through its role as a regulator of utility-service pricing.

Energy-efficiency opportunities are physical, long-lasting changes that reduce energy use while maintaining or improving performance (e.g., high-efficiency lighting, Energy Star appliances, fuel-efficient cars). Energy conservation is achieved when consumers limit or reduce their use of energy-consuming devices (e.g., turn off lights, drive fewer miles).

It is important to maintain a comfortable margin between the highest point of energy demand and the supply system's capacity in order to avoid events such as electric-grid blackouts, transmission constraints, and price volatility. For example, electric-grid system operators calculate and maintain reserve margins to account for real-time supply-and-demand fluctuations caused by events such as sudden loss of generation or severe weather. As reserve margins shrink, markets are at increased risk for disruptions and price spikes. Sustainable demand reductions based on conservation and energy efficiency improve reserve margins and reduce supply-side needs and long-term capacity increases.

This chapter presents information on the amount of achievable energy efficiency and conservation in Virginia; identifies cost-effective energy-efficiency and conservation measures that could significantly reduce energy demand; and discusses ways in which Virginia can take a leadership role in setting energy-efficiency and conservation policy.

This Plan sets an overall goal to reduce the rate of growth of energy use over the base case by 40 percent. To reach this level, the Plan sets fuel-specific goals to reduce "electric use by 10 percent by 2022 as called for in the 2007 electric re-regulation legislation, to reduce natural gas consumption by more than 7 percent, to reduce non-transportation petroleum use by 10 percent, and to reduce transportation energy use by 5 percent.

3.1 Improving Energy Efficiency and Conservation in Virginia

Virginia's energy policy objectives call for using energy resources more efficiently and facilitating conservation. Virginia has a history of relatively low energy costs compared with other states-which means financial returns and payback from implementing efficiency and conservation measures have been limited. States with historically high costs have established a range of programs that can serve as models for Virginia.

Energy-efficiency and conservation programs can include many strategies. A few of the most important are:

- Consumer education.
- Training for service and design professionals.
- Financial incentives that influence consumers' decisions.
- Increasing energy-efficiency building and equipment standards.
- Utility rates and programs (time-of-use rates, demand response, etc.).
- Research and development programs.
- Transportation improvements and mass transit incentives.

The Virginia Energy Plan Advisory Group provided input on the Plan at five public workshops.[28] The advisory group agreed that Virginia should develop and implement a full range of cost-effective energy-efficiency and conservation programs.

Placing a high priority on energy efficiency and conservation is compatible with the findings of the Appalachian Regional Commission (ARC) Energy Blueprint, the

[28]These workshops were held in fall 2006 in the cities of Abingdon, Annandale, Lexington, Williamsburg, and Virginia Beach.

Chapter 3

Energy Efficiency and Conservation

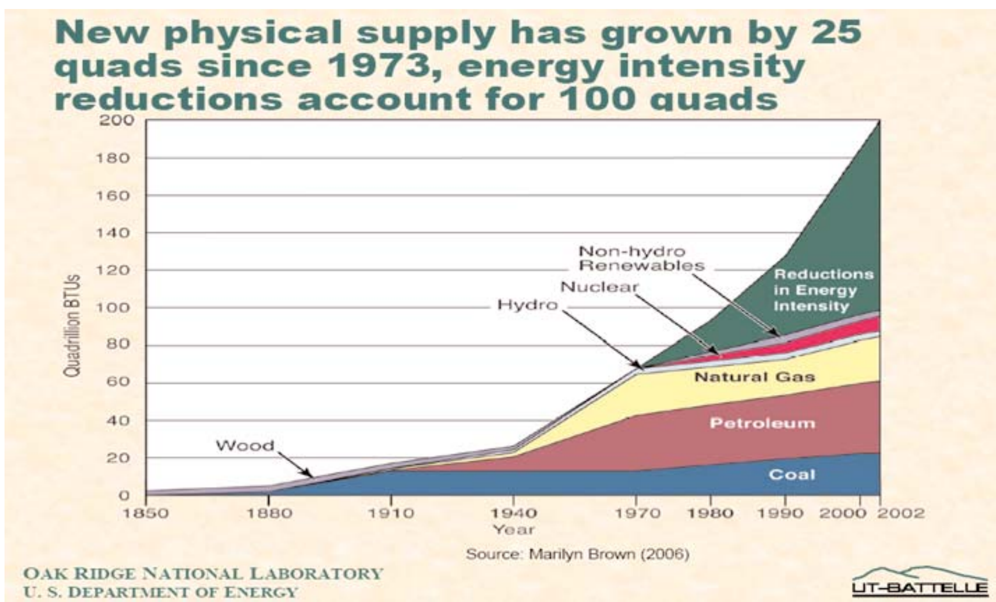
continued

2005 National Energy Policy Act, and Virginia's 2006 Economic Development Strategic Plan.[29] Strategic objective #1 in the ARC report, "Energizing Appalachia: A Regional Blueprint for Economic and Energy Development" is to "promote energy efficiency in Appalachia to enhance the Region's economic competitiveness."[30] The 2006 National Action Plan for Energy Efficiency, developed by more than fifty leading government, utility, non-profit, industry, and business organizations, notes that "improving the energy efficiency of our homes, businesses, schools, governments, and industries-which consume more than 70 percent of the natural gas and electricity used in the country-is one of the most constructive, cost-effective ways to address these challenges. Increased investment in energy efficiency in our homes, buildings, and industries can lower energy bills, reduce demand for fossil fuels, help stabilize energy prices, enhance electric and natural gas system reliability, and help reduce emissions of air pollutants and greenhouse gases."[31] The Virginia Energy Plan uses concepts from the National Action Plan for Energy Efficiency and complements this national effort.

Energy-efficiency efforts have already had a significant impact on energy use (see Figure 3-1). Without them, the nation's energy use would have more than doubled between 1973 and 2002.

Energy-efficiency efforts have already had a significant impact on energy use. Without them, the nation's energy use would have more than doubled between 1973 and 2002.

Figure 3-1 Impact of Energy-Efficiency Efforts on U.S. Energy Intensity, 1973-2002



[29]State of Virginia, "Virginia Leading the Way, Governor Kaine's Economic Development Strategic Plan," 2006, p. 15.
[30]ARC, "Energizing Appalachia: A Regional Blueprint for Economic and Energy Development," October 2006, p. 1.
[31]U.S. Department of Energy and U.S. Environmental Protection Agency, National Action Plan for Energy Efficiency, July 2006.

3.2 History of Energy-Efficiency Savings and Spending by Electric Utilities in Virginia

The U.S. Department of Energy's Energy Information Administration (EIA) collects annual energy-efficiency spending and savings data from U.S. electric utilities. Virginia ranks low on energy-efficiency savings originating from utility programs. Of a hundred investor-owned utilities that provided information to EIA on energy-efficiency savings, the highest-performing Virginia utility ranked sixty-fourth. Western Massachusetts Electric Company (WMECO) ranked first, but Massachusetts had the second-highest electric rates of the fifty states. WMECO began implementing energy-efficiency programs in the 1970s and has already saved more than 15 percent of total annual kilowatt-hour sales as a result.

Virginia should not wait for the rate increase "creep" to cause an unmanageable burden. Virginia can obtain significant savings and environmental benefits through increased investments in energy efficiency and conservation.

Electricity prices are likely to increase in Virginia because of increased fuel costs and the need for infrastructure improvements. While these increases may create an economic burden, they also make efficiency upgrades financially more attractive to consumers and utilities. Higher electric rates mean shorter paybacks on efficiency investments. Virginia should not wait for the rate increase "creep" to cause an unmanageable burden. Virginia can obtain significant savings and environmental benefits through increased investments in energy efficiency and conservation.

The top twenty electric utilities with energy-efficiency programs spend an average of 2.75 percent of annual electric-utility revenues on energy-efficiency programs. These same utilities have already saved an average of 12 percent of their total electric sales through the end of 2005. Typically, every $1 spent by these utilities on energy efficiency saves consumers $3 to $4.

The 2006 National Action Plan for Energy Efficiency reports that utilities are operating energy-efficiency programs at a program cost of about $0.02 to $0.03 per lifetime-kilowatt-hour-saved and $1.30 to $2.00 per lifetime-million-BTUs-saved.[32]

Efficiency and conservation can defer the need for new power generation facilities. Energy-efficiency programs reduce the demand for electricity, reduce emissions from conventional power plants, and provide a more diversified energy-resource mix.

3.3 Opportunities and Challenges with Energy Efficiency and Conservation

Virginia has several opportunities that will help with the development of new energy-efficiency and conservation programs:

- There is a significant amount of cost-effective energy-efficiency savings potential in Virginia. According to data from the U.S. Department of Energy's Energy Information Administration, penetration of energy-efficiency measures is still low for Energy Star appliances and energy-efficient lighting.
- Virginia has a diverse inventory of energy-service companies available to help design and implement aggressive energy-efficiency and conservation programs.
- Virginia has several educational institutions that can train workers for the energy-service industries.
- Virginia has several local "champions" of energy-efficiency programs (e.g., Arlington, Fairfax, and Loudoun Counties) that have established momentum and can serve as models in designing and implementing new energy-efficiency and conservation programs.
- Virginia has kept its energy-related building codes up to date with model codes, resulting in substantial savings in new building energy use.

Virginia's challenges in energy efficiency and conservation include:

- Because few formal energy-efficiency, conservation, and demand-control programs have been in place in Virginia, a significant transition will be needed for energy-efficiency programs to be fully implemented and recognized by consumers. Effecting

[32]U.S. Department of Energy and U.S. Environmental Protection Agency, National Action Plan for Energy Efficiency, July 2006, p. 1-6.

Virginia has no established funding source for energy-efficiency and conservation programs. Most states with a successful history of efficiency programs provide significant funding resources.

change in consumer behavior will require a significant shift in attitudes and awareness.

- The State Corporation Commission has historically given different weights to financial tests when considering the cost effectiveness of energy-efficiency programs. It historically has used the Rate Impact Measure Test as the primary test of cost effectiveness. The Total Resource Cost Test indicates whether an energy-efficiency measure or program has a cost per lifetime-kilowatt-hour-saved less than the avoided cost of electric generation, transmission, and distribution. The Societal Test assesses costs not directly attributed to utility services. A 2004 study found that twenty-eight states used either the Total Resource Cost or Societal Test as the main determinate of the cost effectiveness of energy-efficiency programs or measures. Virginia should use a mix of the Total Resource Cost Test, Societal Test, Utility/Program Administrator Test, Participant Test, and Rate Impact Measure Test. No one tool should be used solely as a go-no go decision point.
- Model energy codes may not optimize the energy-savings potential in new building construction. Using standards such as Energy Star or Leadership in Energy and Environmental Design (LEED) may offer opportunities for long-term energy savings.
- Virginia has no established funding source for energy-efficiency and conservation programs. Most states with a successful history of efficiency programs provide significant funding resources.
- The largest single piece of Virginia's energy-consumption "pie" is transportation fuel. Strategies such as mitigating traffic congestion, converting truck freight to rail or barge, and improving vehicle miles per gallon represent significant implementation challenges. See Section 3.5.3, Petroleum Energy-Efficiency Potential, for a discussion of transportation fuel efficiency and conservation.
- Energy-conservation and demand-control activities should be evaluated for effectiveness through use of measurement and verification protocols. Programs not meeting planned results should be reevaluated to determine if they should be modified or ended.

3.4 The Case for Energy Efficiency and Conservation

Developing and implementing aggressive energy-efficiency and conservation programs make good business sense for Virginia.

- Numerous energy-efficiency measures have a cost per lifetime-kilowatt-hour-saved[33] that is less than the cost per kilowatt-hour for electric generation from new power plants. As shown in Table 3-1, the cost of many residential energy-efficiency measures is lower than 5 cents per lifetime-kilowatt-hour-saved (5 cents per kilowatt-hour is the approximate cost of generation provided by a new coal-fired power plant).
- Cost-effective energy-efficiency and conservation programs can reduce emissions of nitrous oxide, sulfur dioxide, carbon dioxide, and particulates.
- Energy-efficiency and conservation programs can be viewed as an energy resource in energy planning. Many energy-efficiency and conservation measures can be deployed to reduce demand much more rapidly and less expensively than supply-side options can increase production.
- As Virginia's population, business community, and energy needs continue to grow, energy efficiency and conservation can defer the need for new energy-supply facilities and the associated environmental burdens they place on land, water, and air resources.
- Energy efficiency and conservation can make businesses (and homes) more comfortable and more productive by improving lighting levels and reducing glare.
- Energy efficiency and conservation can help businesses reduce operating costs, thus making businesses more efficient and increasing profits that can be reinvested. The Wisconsin Focus on Energy program, for example,

[33]The cost of energy-efficiency measures is calculated over their entire useful life, not just one year. For example, a typical compact fluorescent lightbulb lasts seven years, and the levelized cost per lifetime-kWh-saved reflects the entire useful life of the bulb, not just the first year.

reported that forty-six new full-time jobs are created in the state for every $1 million invested in energy-efficiency programs.[34]

Other measures will not save significant amounts of energy but can reduce the peak demand for electricity. For example, the Northern Virginia Electric Cooperative has installed devices for a substantial percent of its customers which allows the co-op to change air-conditioning and hot water heater cycling during peak hours with significant peak savings. Many peak demand control savings are now cost effective due to the availability of smart metering and time-of-usage electricity rates.

Energy-efficiency and conservation programs tend to relieve supply and demand pressure without the cost, environmental impact, and time delays associated with constructing new infrastructure (e.g., large power plants).

Table 3-1 Examples of Residential Energy-Efficiency Measures Costing Less than $.05 per Lifetime-Kilowatt-Hour-Saved

Energy-Efficiency Measure	Levelized Cost per Lifetime-kWh-Saved
Energy Star dehumidifier	$0.000
Compact fluorescent lightbulb	$0.003
Low-flow shower head	$0.008
Programmable thermostat	$0.008
Water-heater blanket	$0.008
Low-flow faucet aerator	$0.018
Efficient oil furnace fan motor	$0.021
Efficient natural gas furnace fan motor	$0.021
Efficient propane furnace fan motor	$0.021
Standby power	$0.023
Insulation and weatherization	$0.024
Energy Star windows	$0.033
Energy-efficient water heating	$0.035
Energy Star single-room air conditioner	$0.036
Energy Star-compliant, side-by-side refrigerator	$0.045
Energy Star-compliant, bottom-mount freezer-refrigerator	$0.049
Low-income insulation and weatherization	$0.049

Energy-efficiency and conservation programs provide a variety of environmental benefits.[35] The potential for carbon regulation and nuclear waste disposal costs creates a risk that Virginia's low-cost generation resources may cost more in the future. Adding energy efficiency and conservation to the mix reduces this risk. Energy-efficiency and conservation programs tend to relieve supply and demand pressure without the cost, environmental impact, and time delays associated with constructing new infrastructure (e.g., large power plants). Utilities and their consumers face less technical and financial risk if there is less need to construct new facilities.

[34]Data obtained from Wisconsin Focus on Energy program evaluation report, available at www.focusonenergy.com.
[35]"The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest," prepared for the Hewlett Foundation Energy Series by the Southwest Energy Efficiency Project, November 2002. See Chapter 5 for more discussion about energy and the environment.

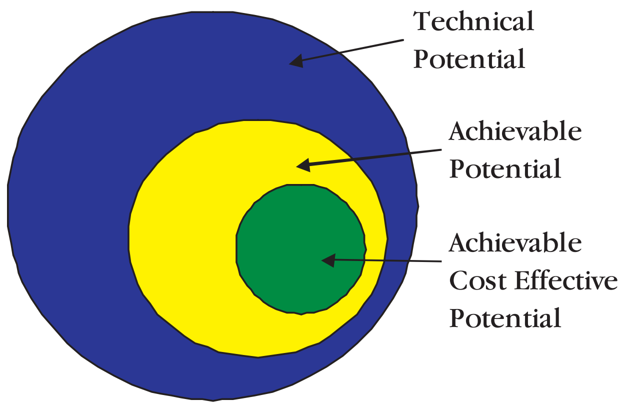
3.5 Energy-Efficiency and Conservation Potential in Virginia

It is standard practice, when preparing an assessment of energy savings in a state or region, to develop three levels of savings potential: technical, achievable, and achievable cost effective.

- Technical potential is the complete penetration of all energy-efficiency measures that are technically feasible from an engineering perspective, regardless of cost.
- Achievable potential is the market penetration that can be achieved with a concerted, sustained campaign that requires programmatic support levels beyond what can be justified on a strictly economic basis.
- Achievable cost effective potential is the potential for the realistic penetration of energy-efficient measures based on a cost-effectiveness evaluation. High levels of support are required, but measured results should exceed associated program costs.

Figure 3-2 depicts the relationship between these three categories (this diagram is for illustrative purposes only and does not reflect the scale of savings for Virginia). To develop the achievable cost effective potential, only those efficiency measures that have a levelized cost per lifetime-million-BTUs-saved lower than the cost of energy supply (i.e., electricity, natural gas, fuel oil, etc.) are considered. The analyses provided in this Plan rely on several studies to estimate cost-effective energy-efficiency and conservation opportunities in other states. Estimated efficiency savings from these studies were applied to develop a forecast of Virginia's potential.

Figure 3-2 Venn Diagram of the Stages of Energy Savings Potential



3.5.1 Electricity Energy-Efficiency Potential

Table 3-2 presents the results of fifteen electricity energy-efficiency potential studies completed for other states and regions. Connecticut, Georgia, North Carolina, and Vermont have a total achievable cost effective electricity savings potential of 13, 9, 14, and 19 percent, respectively, over the next decade. Table 3-2 also shows the incentive-level assumptions (for incentives paid to program participants) for these studies. Incentives range from a low of 15 percent to a high of 100 percent of energy-efficiency-measure costs.

Table 3-2: Comparison of Potential Electricity Savings from Studies in Other States

Percent of Total Electricity (MWh) Sales														
Sector	Conn. *2012 [1]	California 2016 [2]	Florida 2017 [3]	Georgia 2015 [4]	Big Rivers (KY) 2015 [5]	Mass. 2007 [6]	North Carolina 2016 [7]	New York 2012 [8]	NY/NJ/PA 2011 [9]	Oregon 2013 [10]	Puget Sound (WA) 2023 [11]	Southwest 2020 [12]	Texas 2017 [13]	Vermont 2015 [14]
Technical Potential														
Residential	21%	39%		33%	26%		40%	37%		28%		26%		40%
Commercial	25%	27%		33%			32%	41%		32%		37%		40%
Industrial	20%	18%		17%	11%		24%	22%		35%		33%		21%
Total	***24%***	***30%***		***29%***			***33%***	***37%***		***31%***		***33%***		***35%***
Achievable Potential														
Residential	17%			21%	18%		20%	26%	35%		17%			26%
Commercial	17%			22%			22%	38%			7%			24%
Industrial	17%			15%	9%		18%	16%	41%		0%			15%
Total	***17%***			***20%***			***20%***	***30%***			***12%***			***22%***
Achievable Cost Effective Potential														
Residential	13%	13%		9%	16%	31%	17%				7%			21%
Commercial	14%	6%		10%	10%	21%	12%				6%			21%
Industrial	13%	10%		7%	9%	21%	12%				0%			15%
Total	***13%***	***10%***	***10%***	***9%***	***12%***	***24%***	***14%***				***6%***		***12%***	***19%***
Incentive Level as a Percent of Incremental Cost														
¥Percentage	51–70%	Average between 2004 incentives and full incremental cost		25, 50, 100%	50%	N/A	50%	20–50%		N/A		15–25%		50%
£Source Page	p. 30	p. ES-2		p. 2-11			p. 3	p. 3-7				p. 5-10		

* Represents the year by which the percentage savings will be achieved.

¥ Reports the assumptions used in each study relating to the level of financial incentives paid to consumers who purchase high-efficiency equipment. In a few of the studies, more than one level of financial incentives was considered.

£ Indicates where the incentive-level assumption can be found in each study.

1. GDS Associates, "Independent Assessment of Conservation and Energy Efficiency Potential for Connecticut and the Southwest Connecticut Region, Appendix B," June 2004.
2. Itron et al., "California Energy Efficiency Potential Study," vol. 1, May 2006. Achievable cost effective potential is defined as a market potential scenario where incentives are the average between 2004 incentive levels and full measure cost.
3. R. Neal Elliott et al., "Potential for Energy Efficiency and Renewable Energy to Meet Florida's Growing Electricity Needs," ACEEE report E072, February 2007.
4. Georgia Environmental Facilities Authority, "Assessment of Energy Efficiency Potential in Georgia - Final Report," prepared by ICF Consulting, May 5, 2005.
5. "The Maximum Achievable Cost Effective Potential for Electric Energy Efficiency In the Service Territory of the Big Rivers Electric Corporation," prepared for Big Rivers Electric Cooperative by GDS Associates, November 2005.
6. "Remaining Electric Energy Efficiency Opportunities in Massachusetts: Final Report," prepared for program administrators and Massachusetts Division of Energy Resources by RLW Analytics, Inc. and Shel Feldman Management Consulting, June 7, 2001.
7. GDS Associates, "A Study of the Feasibility of Energy Efficiency as an Eligible Resource as Part of a Renewable Portfolio Standard for the State of North Carolina," December 2006.
8. New York State Energy Research and Development Authority, "Energy Efficiency and Renewable Energy Resource Development Potential in New York State - Final Report," prepared by Optimal Energy, Inc., August, 2003.
9. ACEEE, "Energy Efficiency and Economic Development in New York, New Jersey, and Pennsylvania," 1997.
10. "Energy Efficiency and Conservation Measure Resource Assessment for the Residential, Commercial, Industrial, and Agricultural Sectors," prepared for the Energy Trust of Oregon by Ecotope, Inc., ACEEE, and the Tellus Institute, January 2003.
11. "Assessment of Long-Term Electricity and Natural Gas Conservation Potential in Puget Sound Energy Service Area 2003–2024," prepared for Puget Sound Energy by KEMA-XENERGY/Quantec, August 2003.
12. "The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest," prepared for Hewlett Foundation Energy Series by Southwest Energy Efficiency Project, November 2002.
13. ACEEE, "Potential for Energy Efficiency, Demand Response, and Onsite Renewable Energy to Meet Texas' Growing Electricity Needs," ACEEE report E073, March 2007.
14. Vermont Department of Public Service, "Vermont Electric Energy Efficiency Potential Study, Final Report," prepared and submitted by GDS Associates, Inc., January 2007. This study includes fuel shifting programs to shift residential customers away from electric space- and water-heating appliances and from electric clothes dryers.
15. Energy Center of Wisconsin, "Energy Efficiency & Customer-Sited Renewable Energy: Achievable Potential in Wisconsin: 2006–2015," November 2005. Wisconsin reported combined results for commercial and industrial sectors as C&I.

Electricity Savings in Virginia in Five and Ten Years

Tables 3-3 and 3-4 present estimates of technical and achievable cost effective potential savings for Virginia in five and ten years for electricity by sector. Because no Virginia-specific study has been performed, forecast estimates have been derived from the average of the savings found in Connecticut, Georgia, North Carolina, and Vermont.

Cumulative annual achievable cost effective savings potential in Virginia is estimated to be 8,868 gigawatt-hours (GWh) in five years and 19,355 gigawatt-hours in ten years. The savings represent the total electricity savings in the fifth and tenth years, respectively, from the energy-efficiency measures examined in this study. The cumulative annual achievable cost effective potential across all sectors over ten years is estimated to be 14 percent.

Table 3-3 Electric Energy Savings Potential in Five Years for Virginia

Level of Potential Savings	Cumulative Annual Savings Potential in Five Years (GWh)	% of Five-Year GWh Consumption Forecast
Residential Sector		
Technical Potential	17,268	34%
Achievable Cost Effective	3,542	8%
Commercial Sector		
Technical Potential	16,794	33%
Achievable Cost Effective	3,907	8%
Industrial Sector		
Technical Potential	5,403	21%
Achievable Cost Effective	1,419	6%
Total - All Sectors		
Technical Potential	39,465	30%
Achievable Cost Effective	8,868	7%

Note: The five-year electricity savings potential estimate for Virginia is the average of Connecticut, Georgia, North Carolina, and Vermont, which are shown in Table 3-2.

Table 3-4 Electric Energy Savings Potential in Ten Years for Virginia

Level of Potential Savings	Cumulative Annual Savings Potential in Ten Years (GWh)	% of Ten-Year GWh Consumption Forecast
Residential Sector		
Technical Potential	17,268	34%
Achievable Cost Effective	7,732	15%
Commercial Sector		
Technical Potential	16,794	33%
Achievable Cost Effective	8,526	17%
Industrial Sector		
Technical Potential	5,403	21%
Achievable Cost Effective	3,097	12%
Total - All Sectors		
Technical Potential	39,465	30%
Achievable Cost Effective	19,355	14%

Note: The ten-year electricity savings potential estimate for Virginia is the average of Connecticut, Georgia, North Carolina, and Vermont, which are shown in Table 3-2.

Chapter 3
Energy Efficiency and Conservation
continued

In summary, if Virginia were to invest significantly in energy efficiency and conservation and to reach the 14 percent achievable cost effective savings level, it could defer or postpone the need for 5,495 megawatts of new electric generating capacity within ten years. Meeting this goal will require a combination of government, utility, non-profit, industry, and business efforts. Needed actions include:

- Financial incentives to utility customers.
- Marketing.
- Administration.
- Planning.
- Program evaluation and metrics.

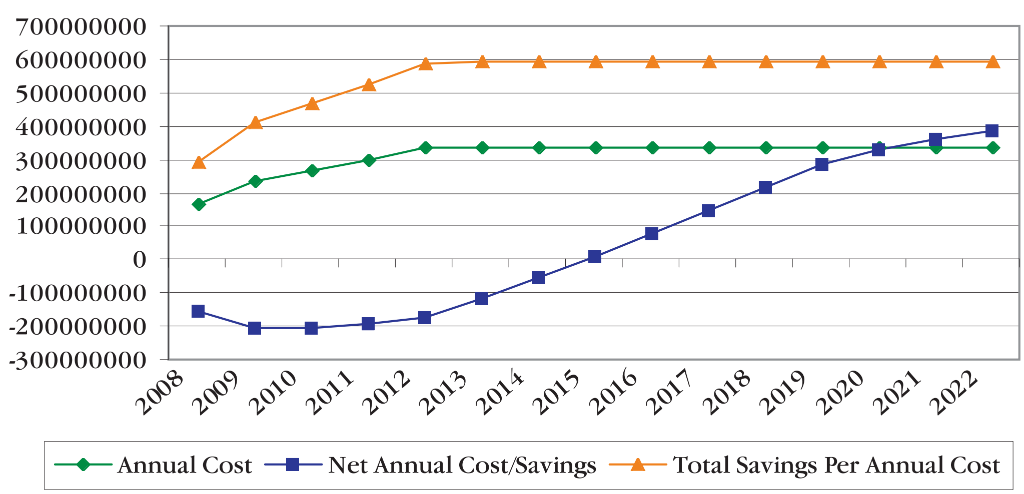
A January 2005 report from the American Council for an Energy Efficient Economy (ACEEE), based on research from leading energy-efficiency states, documents that a portfolio of electric energy-efficiency programs can save electricity at 3 cents per lifetime-kilowatt-hour-saved.[36] Using this figure, the present value of total costs to achieve Virginia's 14 percent electricity savings would be approximately $4.6 billion over ten years. The present value of program electricity savings would be approximately $13.8 billion.[37]

Legislation enacted in 2007 set a goal to reduce 2022 electric use by 10 percent of 2006 retail consumption through conservation and efficiency. Reaching the 10 percent goal would defer or postpone the need for approximately 3,900 megawatts of new electric generation capacity by 2022, equivalent to four or five large generation stations.

Virginia consumers would save in the range of $200 to $700 million (net savings after costs) through 2022 (average $15 to $50 million per year), depending on the value assigned to electricity savings. Consumers would receive substantial lifetime savings for their investments in efficiency. Total savings over the lives of the measures would range from $300 to $590 million for each yearly investment in energy-efficiency measures.

Achieving these savings would require a substantial up-front investment. Using the 3 cents cost per lifetime-kilowatt-hour-saved discussed above, utilities and consumers together would have to invest an average of approximately $300 million per year over the fifteen-year life of the program ($100 to $120 million by electric utilities, matched by $180 to $200 million by consumers). Consumers as a whole would see a net increase in costs because of the investments in efficiency over the first seven or eight years, followed by net savings over the next seven or eight years. These costs and savings are illustrated in Figure 3-3.

Figure 3-3 Costs and Savings from Electric Efficiency Programs



[36] ACEEE, "Examining the Potential for Energy Efficiency to Help Address the Natural Gas Crisis in the Midwest," ACEEE report UO51, January 2005, p. 33. The estimates for Virginia are extrapolations from other state studies. No specific cost and savings study has been completed for Virginia. Therefore, the projected costs and savings should be treated as rough estimates. See also the 2006 National Action Plan for Energy Efficiency.

[37] For example, according to the 2006 Annual Report to the Maine Legislature, Efficiency Maine programs saved 75 gigawatt-hours in fiscal year 2006, and the overall benefit/cost ratio for all Efficiency Maine programs in FY 2006 was 3 to 1.

Chapter 3

Energy Efficiency and Conservation

continued

3.5.2 Natural Gas Energy-Efficiency Potential

Table 3-5 presents the results of recent natural gas energy-efficiency potential studies for nine states, the Midwest, and the nation as a whole. The technical potential for natural gas savings ranged from 20 to 38 percent in the seven states for which that figure was calculated. An ACEEE study concluded that the national technical potential for gas energy efficiency is 41 percent of annual national gas sales.[38] The total achievable cost effective potential for natural gas savings ranged from 4 to 28 percent.

Table 3-5: Comparison of Potential Natural Gas Savings from Recent Studies in Other States

Percent of Total Natural Gas Sales										
	California	Utah	Oregon & Washington	New Mexico	New York	Georgia	New Jersey	Wisconsin	Midwest	National
Sector	2016 [1]	2013 [2]	2013 [3]	2014 [4]	2012 [5]	2010 [6]	2020 [7]	2015 [8]	2015 [9]	2013 [10]
Technical Potential										
Residential	28%	46%	24%	62%		31%	46%			48%
Commercial	14%	29%	18%	17%		28%	15%			20%
Industrial	13%	-	5%	8%		4%	15%			
Total	***21%***	***38%***	***20%***	***36%***		***19%***	***32%***			***41%***
Achievable Cost Effective Potential										
Residential	4%	26%	5%	17%	27%	5%		3%	7%	9%
Commercial	3%	11%	5%	10%	33%	10%		3%	6%	8%
Industrial	4%		2%	6%	22%	5%		3%	7%	
Total	***4%***	***20%***	***5%***	***12%***	***28%***	***6%***	***9%***	***5%***	***7%***	***9%***
Incentive Level as a Percent of Incremental Cost										
¥Percentage	Average b/w 2004 incentives and full incremental cost	50%	100%	50%	50%	100%	80%			
£Page Source	pg ES-2		pg 2-4		5-16 : 5-24	pg 2-11	pg 2-7			

Notes

* Represents the year by which the percentage savings will be achieved.

¥ Reports the assumptions used in each study relating to the level of financial incentives paid to consumers who purchase high-efficiency equipment. In a few of the studies, more than one level of financial incentives was considered.

£ Indicates where the incentive-level assumption can be found in each study.

1. Itron et al. "California Energy Efficiency Potential Study," Vol. 1, May 2006. Achievable Cost Effective Potential is defined as a market potential scenario where incentives are the average between 2004 incentive levels and full measure cost
2. GDS Associates, Inc. "The Maximum Achievable Cost Effective Potential for Gas DSM in Utah for the Questar Gas Company Service Area" June 2004.
3. "Assessment of Long Term Electricity and Natural Gas Conservation Potential in Puget Sound Energy Service Area 2003-2024," prepared for Puget Sound Energy by KEMA-XENERGY/Quantec, August 2003. The published study is for twenty years. Numbers reported in this table are half of published numbers.
4. GDS Associates, Inc. "The Maximum Achievable Cost Effective Potential for Natural Gas Energy Efficiency in the Service Territory of PNM," May 2005.
5. Optimal Energy et al. "Natural Gas Energy Efficiency Resource Development Potential in New York State," October 2006.
6. Georgia Environmental Facilities Authority, "Assessment of Energy Efficiency Potential in Georgia - Final Report" prepared by ICF Consulting, May 5, 2005.
7 KEMA, Inc. "New Jersey Energy Efficiency and Distributed Generation Market Assessment," final report to Rutgers University Center for Energy, Economic and Environmental Policy, November 2004. Potential is calculated as Gas Savings in 2020 as a % of 2004 Sales.
8. Energy Center of Wisconsin. "Energy Efficiency & Customer-Sited Renewable Energy: Achievable Potential in Wisconsin: 2006-2015, November 2005. Wisconsin reported combined results for commercial and industrial sectors as C&I.
9. ACEEE. "Examining the Potential for Energy Efficiency to Help Address the Natural Gas Crisis in the Mid-West. Report UO51, January 2005.
10. ACEEE. " The Technical, Economic, and Achievable Potential for Energy Efficiency in the United States: A Meta-Analysis of Recent Studies." Proceedings from the 2004 Buildings Summer Study. August 2004.

[38] ACEEE, "The Technical, Economic, and Achievable Potential for Energy Efficiency in the United States: A Meta-Analysis of Recent Studies: Proceedings from the 2004 Buildings Summer Study," 2004.

Chapter 3

Energy Efficiency and Conservation

continued

Natural Gas Savings in Virginia in Five and Ten Years

Tables 3-6 and 3-7 present estimates of cumulative annual technical and achievable cost effective potential savings for Virginia in five and ten years for natural gas by sector. As no Virginia-specific study has been performed, the figures in these two tables were derived from results listed for seven of the studies in Table 3-5 (Utah, New Mexico, New Jersey, Oregon and Washington, Georgia, Wisconsin, and the Midwest).[39]

The cumulative annual technical savings potential for all sectors is estimated to be 64 trillion BTUs (MMBTUs).[40] The cumulative annual achievable cost effective savings potential is estimated to be 9.3 trillion BTUs in five years and 21.1 trillion BTUs in ten years. The savings numbers in the two tables represent the total natural gas savings across the entire fifth and tenth years, respectively, from the energy-efficiency measures examined in this study.

Table 3-6 Natural Gas Energy Savings Potential in Five Years for Virginia

Level of Potential Savings	Cumulative Annual Savings Potential in Five Years (MMBTUs)	% of Five-Year MMBTU Consumption Forecast
Residential Sector		
Technical Potential	41,107,818	42.0%
Achievable Cost Effective	4,502,900	5.0%
Commercial Sector		
Technical Potential	16,611,319	21.0%
Achievable Cost Effective	2,911,334	4.0%
Industrial Sector		
Technical Potential	6,072,901	6.0%
Achievable Cost Effective	1,862,611	2.0%
Total - All Sectors		
Technical Potential	63,792,039	22%
Achievable Cost Effective	9,276,845	3.5%

Note: The five-year natural gas savings potential estimate for Virginia is the average of of Utah, New Mexico, New Jersey, Oregon and Washington, Georgia, Wisconsin, and the Midwest, which are shown in Table 3-5.

Table 3-7 Natural Gas Energy Savings Potential in Ten Years for Virginia

Level of Potential Savings	Cumulative Annual Savings Potential in Ten Years (MMBTUs)	% of Ten-Year MMBTU Consumption Forecast
Residential Sector		
Technical Potential	41,107,818	42.0%
Achievable Cost Effective	9,787,576	10.0%
Commercial Sector		
Technical Potential	16,611,319	21.0%
Achievable Cost Effective	6,328,122	8.0%
Industrial Sector		
Technical Potential	6,072,901	6.0%
Achievable Cost Effective	5,060,751	5.0%
Total - All Sectors		
Technical Potential	63,792,039	22.2%
Achievable Cost Effective	21,176,448	7.4%

Note: The ten-year natural gas savings potential estimate for Virginia is the average of of Utah, New Mexico, New Jersey, Oregon and Washington, Georgia, Wisconsin, and the Midwest, which are shown in Table 3-5.

[39]The estimates for Virginia are extrapolations from other state studies. No specific cost and savings study has been completed for Virginia. Therefore, the projected costs and savings should be treated as rough estimates. The calculations omit the results of the studies from California and New York because they are significant outliers (either too low or too high).

[40]The 64 million MMBTU figure represents the full technical potential for cumulative annual natural gas savings if all technically feasible natural gas energy-efficiency measures were implemented. The estimates of cumulative annual MMBTU savings for the achievable cost effective potential represent what could be saved after screening measures for cost effectiveness, and after adjusting for consumer acceptance of energy-efficiency measures.

In summary, if Virginia were to invest in programs to reach achievable cost effective goals, natural gas reductions of approximately 7.4 percent, or 21.2 trillion BTUs, are predicted within ten years. At a current retail cost in Virginia in 2007 of $12.08 per thousand cubic feet, this would translate to retail savings for customers of $257 million annually. According to recent studies in other states, $1 invested in natural gas energy-efficiency programs results in approximately $3 of natural gas savings.

As with electricity efficiency and conservation, implementation of natural gas efficiency and conservation programs will require up-front investment by natural gas utilities and consumers to overcome barriers to consumer implementation. Natural gas ratemaking policies, such as those addressing rate decoupling, must be carefully crafted to provide both protection to consumers and adequate recovery of utilities' program costs and local distribution infrastructure costs.

According to recent studies in other states, $1 invested in natural gas energy-efficiency programs results in approximately $3 of natural gas savings.

3.5.3 Petroleum Energy-Efficiency Potential

Transportation changes will have the largest effect on petroleum use in Virginia. Options to reduce energy use for transportation include reducing vehicle miles traveled and increasing fleet efficiencies.

Transportation changes will have the largest effect on petroleum use in Virginia. Options to reduce energy use for transportation include reducing vehicle miles traveled and increasing fleet efficiencies.

Vehicle miles traveled can be reduced through demand management, moving freight from truck to rail or barge, increasing use of mass transit and other alternatives to automobile use, and increasing use of high-occupancy vehicle and high-occupancy tolling lanes.

Transportation Demand Management - Using alternative methods (e.g., telecommuting, flex-time variable work schedule, ride-sharing, and car-sharing) for the daily commute.

Transportation demand-management programs can reduce fuel consumption by reducing automobile use and increasing occupancy of automobiles. A 2001 Department of Rail and Public Transportation study found that the average telecommuter in the Fredericksburg area made 2.86 fewer trips weekly than the average non-telecommuter. This resulted in an individual annual fuel savings of 486 gallons and a reduction in carbon dioxide emissions of 4.7 tons annually per individual.[41] As the number of people who telecommute increases, these benefits will grow. Flex-time variable work schedules allow employees to travel outside times of high congestion.

Hurdles to successful implementation of transportation demand-management programs include the lack of public and business training and education, competing funding priorities, user flexibility, and limited availability of broadband in some areas of the state. Additionally, some of these programs require initial large-scale investment and supporting infrastructure.

Secondary effects of telecommuting include expanded demand on the broadband infrastructure and more opportunities for midday trips. Ride- and car-sharing could result in decreased automobile ownership and use, reduced user mobility, and reduced carbon dioxide emissions.

Truck Freight to Rail or Barge - Moving freight from diesel trucks onto existing rail infrastructure or barge.[42]

The majority of Virginia's freight moves by trucks on the state highway system. However, it is more fuel efficient to move freight by rail than by truck; rail uses 0.002 gallons of fuel per ton-mile, compared with 0.0175 gallons for the average truck.

Virginia is working with other states and rail companies to develop the Heartland Corridor Project. This project is designed to create a double-decker rail freight line from Hampton Roads to the Midwest. When fully operational, it will remove approximately 150,000 trucks from highways annually and move the containers to rail. This will result in annual fuel savings of 7.6 million gallons of fuel and could potentially reduce carbon dioxide emissions by 84,360 tons annually.[43] The Heartland Corridor Project is receiving financial support through the Department of Rail and Public Transit's Rail

[41] Federal Transit Administration, National Transit Database 2004.
[42] HDR/HLB Decision Economics, Inc., Virginia Department of Rail and Public Transit Benefit Cost Analysis, 1997.
[43] Environmental Protection Agency, Emission Facts (EPA420-F-05-001), 2005.

Enhancement Program, which has made energy efficiency an explicit goal.

Another potential project is the James River Barge Line. According to reports, a Hampton Roads maritime enterprise has asked the federal government for $500,000 to help initiate a project that would take some of the growing volume of cargo containers off I-64 and U.S. 460 between Hampton Roads and Richmond. Beginning as a weekly service, the line would move barges laden with containers and guided by tugboats about 80 miles up the James River to the Port of Richmond. The service would move at least 5,000 containers in the first year. By 2015, the goal is to transport about 250,000 containers annually with two large barges making trips twice a week.[44]

Other opportunities are being developed to move freight from truck to rail. For example, the Department of Rail and Public Transportation is completing a 2007 study of the feasibility and cost of diverting I-81 freight from truck to rail.

Virginia provided for substantial new investment in rail under the 2007 transportation package. The statewide funding package includes $13 million per year in new funding for the Rail Enhancement Fund.

Hurdles associated with moving truck freight to rail include additional capital investment and infrastructure (including capacity of existing rail corridors, facilities, routes, and rolling stock and equipment), reliability, timeliness and predictability of service, funding priorities, and business perceptions.

Increased freight traffic could cause conflicts with existing passenger rail service because of limited rail capacity.

Secondary effects of moving truck freight to rail include reducing roadway congestion, reducing accidents (accident rates per ton-mile are considerably lower for rail than for trucks), and reducing heavy-truck roadway damage. There is a potential for additional reduction in emissions from converting locomotives to a clean-burning fuel. An increase in the amount of freight moved by rail could displace jobs in the trucking industry and could disrupt passenger rail service because of additional freight rail traffic.

Transit - Improved public transportation for citizens

Virginia is home to fifty-six bus, subway, intercity rail (AMTRAK), and commuter rail (Virginia Railway Express) systems. There is one proposed light rail system, in Norfolk.

Public transportation consumes less fuel per passenger-mile than automobiles. In 2004, the average bus in the United States used a gallon of gasoline equivalent per 34.9 passenger-miles, whereas a single-occupant automobile uses a gallon of gasoline equivalent per 19.6 passenger-miles.[45] In 2004, the Virginia Railway Express achieved even greater efficiency, with 74.3 passenger-miles per gallon of gasoline equivalent.

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The average automobile releases 989.8 pounds of carbon dioxide for each 1,000 passenger miles, compared with 555.9 pounds for the average bus and 261.1 pounds for rail.[46] Promoting the use of public transportation will reduce greenhouse gas emissions and lead to improved air quality.

Virginia's 2007 transportation package included a substantial increase in funds to be used for public transit improvements. The statewide package included $60 million funding for transit system capital improvements and $45 million for transit system operations. A substantial amount of the regional transportation funding in the 2007 package also will be allocated to public transportation. For example, Alexandria, Falls Church, and Arlington will use 50 percent of their new revenues on public transportation. The Washington Metropolitan Area Transit Authority and Virginia Railway Express may receive additional funds if revenue raised under the Northern Virginia Transportation Authority exceeds that needed to pay debt service on transportation bonds.

Hurdles to transit use in Virginia include low-density land-development patterns that leave public transit unavailable to many, high capital and operating costs of

[44]"Barge project appears feasible: Hampton Roads firm seeks money to set up service to Richmond," Richmond Times Dispatch, May 8, 2007.
[45]Federal Transit Administration, National Transit Database, 2004.
[46]Environmental Protection Agency, Emission Facts (EPA420-F-05-001), 2005.

Walking and bicycling are the most fuel-efficient forms of transportation. If more people regularly walked and cycled, fuel would be saved, air pollution would be reduced, and less energy would be needed to create, operate, and maintain roadway lane miles and parking facilities.

transit systems, public perception that transit is a lower-quality source of travel, limited frequency of service, funding priorities, and capacity constraints if transit use increases quickly. Increased passenger rail service could cause conflicts with freight traffic in corridors with limited rail capacity.

Secondary effects of transit improvements include potential reduction of roadway congestion, reduction of the number of new lane miles necessary, and possible reduction of highway maintenance expenditures.

Alternative Modes - Using low-fuel methods such as bicycling, walking, or small electric vehicles for individual daily commutes.

Walking and bicycling are the most fuel-efficient forms of transportation. If more people regularly walked and cycled, fuel would be saved, air pollution would be reduced, and less energy would be needed to create, operate, and maintain roadway lane miles and parking facilities. In 2004, the Commonwealth Transportation Board adopted a policy to promote the provision of bicycle and pedestrian accommodations (Policy for Integrating Bicycle and Pedestrian Accommodations).

Significant hurdles stand in the way of increased use of alternate transportation modes. Current low-density land-development patterns discourage nonmotorized transportation by separating residential areas from workplaces, shopping, and other attractions. Walking and bicycling are often perceived by the public as auxiliary activities rather than viable travel modes. Citizens repeatedly cite the lack of safe, convenient facilities for walking and cycling as obstacles to increased use of these modes.

Provision of safe and accessible facilities as well as more compact land use would promote walking and bicycling as viable transportation modes. In many European countries, at least 25 percent of urban trips are by walking or cycling, and in a few countries (e.g., Denmark and The Netherlands), more than 40 percent of these trips are nonmotorized.[47]

High-Occupancy Vehicle (HOV) and High-Occupancy Toll (HOT) Lanes

High-occupancy vehicle (HOV) and high-occupancy toll (HOT) lanes provide the driving public with a new choice: premium and predictable travel conditions on corridors where conditions are otherwise congested. At the same time, they maximize the use of managed lanes (including HOV lanes) without causing traffic service to fall below desired levels.[48]

Traffic volumes on HOT lanes are managed to ensure superior, consistent, and reliable travel times, particularly during peak travel periods. HOT lanes allow HOV and paying non-HOV motorists to travel at higher speeds than vehicles on congested general-purpose lanes. The addition of HOT options to an existing HOV facility may provide traffic-service improvements on congested general-purpose highway lanes. These improvements also have the potential to draw vehicles off other parallel routes and improve traffic efficiency in the corridor. HOT lanes may provide an opportunity to improve the efficiency of existing HOV lanes by filling available "excess capacity" that otherwise would not be used.

Energy savings can be realized through HOV and HOT lanes in several ways. Vehicles operating at constant speeds are more fuel efficient than those traveling in stop-and-go traffic. Secondly, as more riders share vehicles, less energy is used to transport the same number of people. The average vehicle occupancy in the HOV 3+ lanes on the I-95 corridor is 2.54 compared with 1.04 for the general-purpose lanes. The average HOV commuter in those lanes uses only 42 percent of the fuel required to transport a single passenger in the general-purpose lanes.

An important factor in the success of an HOV system is the favorable travel times for drivers in the HOV lanes as compared with those in the general-purpose lanes. In northern Virginia, recent traffic counts document the considerable time savings from use of HOV lanes (see Table 3-8).

[47] Pucher and Dijstra, "Making Walking and Cycling Safer: Lessons from Europe," Transportation Quarterly, 2000.
[48] U.S. Department of Transportation, Federal Highway Administration, "A Guide for HOT Lane Development," March 2003.

Table 3-8 Travel Times for Northern Virginia Drivers in HOV Lanes vs. General-Purpose Lanes

Type of Lane	Route Traveled		
	I-95/395	I-66	Dulles Toll Road
General-purpose	58 min.	69 min.	56 min.
HOV	27 min.	41 min.	31 min.

Fixing a serious maintenance problem, such as a faulty oxygen sensor, can improve mileage by as much as 40 percent.

For every 5-mph decrease on the highway, a typical driver will save 5 percent in fuel.

HOT lanes can provide an additional source of revenue to support transportation improvements such as additional transit service and construction and operation of additional lanes, or to address corridor transit needs or other local demand-management strategies. Some transportation improvements might not be possible without the additional revenue provided by HOT lanes.

With the proposed HOT lanes, bus service on I-95 and 495 would be able to use the new lanes. HOT-lane revenues could be used to double bus service on I-95 and provide the first-ever bus service on the Beltway.

Hurdles to increased HOV and HOT lane use include the substantial capital needs and construction disruption for new lanes.

Increasing transportation efficiency can be accomplished by increasing fleet efficiencies and improving driver habits.

Increasing Fleet Efficiencies

Individuals and businesses should look carefully at fuel efficiency when selecting vehicles and equipment. There are many fuel-efficient options that will meet transportation needs. Consumers should look for higher-efficiency vehicles, hybrid gas-electric vehicles, flex-fuel vehicles that can use gasoline or E85, and new clean-burning diesel vehicles. Virginia should look at opportunities to promote use of new vehicle technologies such as plug-in hybrids.

Savings to consumers can be substantial. Driving a vehicle 12,000 miles per year at 38 miles per gallon versus 28 miles per gallon, at $2.50 per gallon, saves 113 gallons of gasoline and $282.50 per year. This is a 26 percent reduction in gasoline use. Using a very efficient vehicle such as a hybrid electric at 50 miles per gallon would increase savings to 189 gallons and $472.50, a 44 percent decrease in gasoline use. If you own your car for seven years, you would save 791 gallons of gasoline and $1,977.50. Over the seventeen-year average life of a car, this totals a savings of over 1,900 gallons of gasoline and over $4,800 for the energy-efficient car. This would save over 3,200 gallons and $8,000 for the hybrid electric car, equivalent to being rebated almost one-third of the cost of a hybrid car.

Overall fleet efficiencies also can be improved through increasing the Corporate Average Fuel Efficiency (CAFE) standards.

Driving Habits

Vehicle owners should keep vehicles properly maintained. The most important maintenance practices include keeping tire pressures at recommended levels and keeping vehicles properly tuned up. Fixing a car that is noticeably out of tune or has failed an emissions test can improve its gas mileage by an average of 4 percent, though results vary based on the kind of repair and how well it is done. Fixing a serious maintenance problem, such as a faulty oxygen sensor, can improve mileage by as much as 40 percent. More information is available through the Commonwealth's Driver Education Core Curriculum.

Virginians should drive smart to save fuel. Steady acceleration and deceleration, using cruise control, and slowing down can significantly increase fleet efficiencies. Studies show a 5 to 15 percent savings can be achieved by reducing highway speeds 10 miles per hour and by using cruise

In 2001 the United States recycled only 5.5 percent of discarded plastics products, compared with 57 percent in Germany.[50] If the United States could achieve the plastics recycling rate of Germany, it could save 600,000 barrels of petroleum a day.[51]

control. Tests of aggressive verses calm driving in cities show up to 25 percent savings using best driving practices. For every 5-mph decrease on the highway, a typical driver will save 5 percent in fuel.

Drivers also can plan trips to combine stops. This reduces the total number of trips and reduces vehicle miles traveled and energy use.

For every 5 percent per year reduction in gasoline use in Virginia, we would save 260 million gallons of gasoline, save more than $500 million, and reduce carbon dioxide emissions by nearly 2 million tons per year, or approximately 1.5 percent of Virginia's total carbon emissions.

Other Fuel Oil Savings

In 2006, the American Council for an Energy Efficient Economy (ACEEE) completed a study of the technical and achievable potential for saving fuel oil with energy-efficiency measures and practices.[49] The study examined numerous technologies that can save oil in the buildings sector and reported that an aggressive program of energy efficiency could reduce fuel oil consumption nationally 13 percent by 2015 and 21 percent by 2020.

Increased recycling of plastic products also presents significant opportunities for reducing petroleum use. In 2001 the United States recycled only 5.5 percent of discarded plastics products, compared with 57 percent in Germany.[50] If the United States could achieve the plastics recycling rate of Germany, it could save 600,000 barrels of petroleum a day.[51]

3.5.4 Energy Conservation for Low-Income Virginians

The number of Virginia families living in poverty has increased to 795,000 as of mid-2007. More than 370,000 of these households have incomes at or below 130 percent of the federal poverty level and are eligible for low-income energy assistance. These low-income Virginians pay a higher percentage of their income for energy than other Virginians. With little to no discretionary income, they are seriously affected by energy-cost increases. The state operates two programs to assist them.

The Weatherization Assistance Program funds improvements to eligible households, including repairing and replacing heating and cooling equipment, sealing air leaks, and insulating buildings, ducts, and hot water heaters. The average expenditure per home is about $2,800. Approximately 2,000 homes are weatherized each year. Evaluation of the program shows that weatherization can reduce heating and cooling bills by 30 percent or more. In Virginia, participating household energy costs are reduced by approximately $300 per year.

The program targets households that include the elderly, individuals with disabilities, or children, and those households receiving assistance from the Department of Social Services. Because of the need to maintain crews and equipment, this program works most efficiently with a stable flow of funds from year to year; it does not readily react to one-time infusions.

The Low-Income Home Energy Assistance Program (LIHEAP), administered by the Virginia Department of Social Services, helps low-income Virginians-particularly those with the lowest incomes that pay a high proportion of household income for home energy-pay their energy bills. The program also provides crisis assistance and cooling assistance funding. The average recipient household receives $250 through this program, which typically covers about 25 percent of winter energy costs. Approximately 60 percent of households served by this program have annual family incomes of less than $10,000, well below the federal poverty level. These families have little room in their budgets to absorb even modest increases in energy costs, making the need for energy-assistance services even more critical than in previous years. Without increased appropriations, LIHEAP will cover a smaller percentage of households' winter energy costs as energy costs rise, or alternatively will have to further restrict the number of families it can serve.

[49] ACEEE, "Reducing Oil Use Through Energy Efficiency, Opportunities Beyond Cars and Light Trucks," ACEEE report E061, January 2006.
[50] Amory B. Lovins, E. Kyle Datta, Odd-Even Bustnes, Jonathan G. Koomey, and Nathan J. Glasgow, Winning the Oil Endgame: Innovation for Profits, Jobs, and Security (Snowmass, CO: Rocky Mountain Institute, 2004), p. 95.
[51] Ibid.

Low-income Virginians pay a higher percentage of their income for energy than other Virginians. With little to no discretionary income, they are seriously affected by energy-cost increases.

Beginning in 2007, Virginia has put in place a sales-tax holiday for Energy Star products.

A portion of LIHEAP funding is transferred to the Weatherization Assistance Program to pay for energy-efficiency and conservation improvements to households receiving financial assistance.

Primary funding for the program comes from the federal Low-Income Home Energy Assistance Program grant. Virginia has provided additional funding to the program, both from the general fund and Temporary Assistance for Needy Families funds, during times of sharply rising energy costs. Electric and natural gas utilities and faith-based organizations also provide assistance to households that cannot pay their energy bills and face service shut-off.

In an effort to serve as many households as possible and coordinate services, the Virginia Department of Social Services partners with other major energy-assistance programs offered by state agencies and utilities such as Dominion's EnergyShare Program, American Electric Power's Neighbor to Neighbor Program, the Virginia Department for the Aging's Fan Care Program, the Department of Housing and Community Development's Weatherization Programs, and most recently, Citizens Energy Oil Heat Program.

Other states have implemented programs that reduce low-income consumers' energy costs. Examples include utility disconnect moratoriums, discounted rates, and waivers on reconnection fees.

3.5.5 Role of Incentives

Many states, energy-efficiency organizations, and electric and gas utilities offer financial incentives for consumers to purchase energy-efficient products. Beginning in 2007, Virginia has put in place a sales-tax holiday for Energy Star products. In many instances, a high-efficiency product costs more than a standard-efficiency product. The purpose of the incentive is to reduce or eliminate this extra cost. This is particularly important in Virginia because of its history of low electricity prices. Up-front transaction costs for businesses to convert or upgrade to energy-efficient equipment and the inability for customers to justify the cost of an energy-efficient purchase are primary barriers to making a large-scale transition to more efficient products. Tax incentives, grants, rebates, and energy-efficiency mortgages are all proven mechanisms that could be deployed in Virginia.

3.5.6 Role of Consumer Education

Recent market research has shown that lack of information about energy-efficient equipment and building practices is a major barrier that prevents consumers from practicing energy efficiency. Ensuring that Virginians have up-to-date and accurate information on energy-efficient equipment and practices will increase adoption and implementation of energy-efficiency and conservation measures on a large scale.

The National Action Plan for Energy Efficiency recognizes the importance of consumer education and addresses the need to communicate the benefits of and opportunities for energy efficiency. Programs need to document and market the benefits to:

- Customers - based on reduced energy bills, energy cost savings, and return on investment.
- Utilities - based on improved business health, including return on equity, earnings per share, and debt coverage ratios being unaffected.
- Policy makers - based on how a well-designed approach to energy efficiency can have significant societal benefits to the economy, environment, and energy security. Effort is also necessary to educate decision makers that although energy efficiency can be viewed as an important low-cost resource, it does require funding, just as a new supply-side infrastructure requires funding.

Consumers face many types of energy-efficiency and conservation advertising. The federal government provides the Energy Star label. Some states provide a state energy-efficiency or green-product label. Appliances are required to have the yellow Energy Guide label. Many commercial companies provide their own energy labeling system, and make energy-efficiency or savings claims for their products. While many of these claims are verifiable, the Federal Trade Commission and consumer watchdogs have found others to be false (in part because some companies report only best-case projections). These many advertising sources often confuse and overwhelm consumers. In short, there is no single, unbiased source of energy-product labeling-similar to the Underwriters Laboratory (UL) seal for safety-on which consumers can rely.

There should be a uniform energy-efficiency brand label for all types of products and materials.

A firm commitment to improving the energy efficiency of state government will show that the state can lead by example.

There should be a uniform energy-efficiency brand label for all types of products and materials. Virginia should support a national program to extend the Energy Star label beyond appliances, office equipment, and buildings. If this cannot be accomplished, Virginia could help establish and support an independently administered, multistate branding effort that verifies efficiency and an extensive advertising campaign to build brand recognition.

Any consumer-education program should also provide information consumers need to avoid energy-related scams. This consumer-education activity should be coordinated with the consumer protection programs at the Department of Agriculture and Consumer Services and Office of the Attorney General.

Providing home owners, renters, and businesses with energy audits should be part of a consumer energy-education program. Both electronic and field audits, with proper quality control over recommendations, should be provided to help consumers identify cost-effective opportunities to reduce energy use in their homes and businesses.

3.5.7 Role of State Government - Leading by Example

Substantial potential exists for saving energy in government sector operations. A firm commitment to improving the energy efficiency of state government will show that the state can lead by example. Lastly, reducing energy consumption will help improve the state's environmental quality.

Energy is one of several cross-cutting areas determined to have a significant impact on the cost of state government. Operational reviews of these areas have focused on implementing best management practices across state government in order to capture the full potential of increased efficiency. A team of decision makers and subject-matter experts from the Commonwealth of Virginia and private industry worked together with members of the General Assembly to conduct the review and provide a final analysis of recommendations. The review assessed energy best practices being used by private business, Virginia agencies, other states, the federal government, and the provisions of state energy management Executive Order 48 (2007) issued by Governor Kaine.

Executive Order 48, Energy Efficiency in State Government, incorporates several operational review best practices. These include requiring an Agency Energy Manager for those agencies with energy costs exceeding $1 million; design and construction consistent with the energy performance standards of the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system or the federal Energy Star rating; maximizing the use of biodiesel and ethanol in state fleet vehicles; leasing space within a quarter-mile of a bus, trolley, Metro, or commuter rail stop; and purchasing Energy Star-rated appliances.

Additional best practices in state government operations focus on the following areas.

- **Centralized energy procurement.** At present each agency procures energy and energy-related services by issuing a purchase order using a statewide contract. With natural gas, the contract allows the use of various hedging mechanisms, including storage, futures, and cap and slide. Because each agency is procuring a relatively small quantity of gas, it can only spend a limited amount of time procuring gas and often does not get the best deal. When larger blocks of energy are procured, the decision to buy must be approved by a committee that may not meet for several days, sometimes missing the opportunity to lock in the best price. With centralized procurement, a specialist could develop and implement a procurement plan whereby all agencies could meet their budget requirements, lower their risk, ensure adequate supply, and get the best deal possible. Purchasing in blocks of 10,000 decatherms would offer additional savings that are not available to agencies under the present structure.

- **Building energy audits and upgrades through performance contracting.** State agencies could benefit from a building energy audit program that provides a consistent benchmark for evaluating facilities. These audits could identify low-cost savings opportunities that would lead to immediate savings. Agencies would use the audit to determine where to spend energy-efficiency dollars to gain the greatest savings. Audits would provide justification for building and equipment upgrades. State agencies could then issue requests for proposals for installation and servicing of high-efficiency equipment. The cost of the equipment and its installation could be paid through savings on future energy bills.
- **Placing a priority on energy management, and establishing a best practice center to set and initiate actions and initiatives.** Developing consistent standards and practices for state agencies is key to implementing best practices statewide. Virginia could establish a Virginia Energy Management Program using a model similar to that of the Federal Energy Management Program.
- **Building commissioning/recommissioning.** The largest opportunity for energy savings is in the inventory of state-owned buildings. Commissioning is equivalent to a building "tune-up" in which equipment and systems are evaluated, cleaned, and adjusted to restore to peak performance. Studies have shown that the payback to commission an existing building can be as low as 8.4 months.

3.6 Emerging Energy-Efficiency Technologies and Practices

Several energy-efficient products on the horizon should contribute even greater energy-savings potential as they are integrated into the current market. In this Plan, "emerging technologies" refer to those measures that are either not yet commercially available or that are available but have penetrated only a small percentage of the marketplace. Examples include light-emitting diode (LED) lighting, microgeneration systems, and cool roofs.

According to a U.S. Department of Energy study, by 2020 solid-state lighting devices such as LEDs could cut electricity used for illumination by 50 percent.

According to a U.S. Department of Energy study, by 2020 solid-state lighting devices such as LEDs could cut electricity used for illumination by 50 percent. Current market penetration of LEDs is small, but commercial availability should increase substantially in the near future.[52]

Cogeneration systems in the residential sector can produce both useful thermal energy and electricity from a single source of fuel such as oil or natural gas. This complete system is more than 85 percent efficient in converting fuel energy into useful heat and electric power. Residential-scale cogeneration technologies are still in their infancy, and the potential for energy and emissions savings is yet to be firmly established.

Cool roofs consist of materials that reflect the sun's energy from the roof surface, reducing its temperature by up to 100°F and thereby reducing the heat transferred into the building below.[53]

Snap Duct technology is a system of mechanically fastened fittings for flex and hard ducts that snap together to create a long-lasting seal. Testing shows that these fittings can eliminate about 90 percent of the leakage within a duct system, saving up to 21 percent of a heating, ventilating, and air conditioning system's annual energy output.[54]

Networked computer management software, though commercially available, still faces both technical and human interface

[52]David Pescovitz, "LED There Be Light," Berkeley Engineering Lab Notes vol. 2 (8), 2002.
[53]Consumer Energy Center, "Cool Roofs," accessed April 2006 at www.consumerenergycenter.org.
[54]ACEEE, "Emerging Energy-Saving Technologies and Practices for the Buildings Sector," ACEEE report AO42, October 2004.

problems. Companies often disable the energy-efficient controls because of network security concerns. When used appropriately, this software can work with security protocols and save up to 40 percent of a terminal's annual output.[55]

Innovative techniques, technologies, and practices are also penetrating the utility marketplace. New demand-control technologies can be combined with practices such as demand-response programs, time-of-use rates, load aggregating, and curtailment. Demand response and time-of-use rates are designed to reward customers who reduce energy consumption when demand for electricity is high. Rate decoupling allows utilities to adequately capture fixed cost of service without being incentivized to sell more units of energy. Load aggregating promotes economies of scale and allows a group of small customers to purchase as a single entity with increased buying power. Consolidating peaks, improving load factor, and curtailing block load are options that can improve system efficiencies and reduce costs.

Water and materials recycling are integral to the energy equation. Considerable energy goes into treating water to potable quality only to have it used for irrigation or cooling. Collecting and using gray water for purposes such as flushing toilets or for industrial inputs are growing practices. Large amounts of energy can be saved by recycling and reusing materials instead of using virgin products.

Considerable energy goes into treating water to potable quality only to have it used for irrigation or cooling. Collecting and using gray water for purposes such as flushing toilets or for industrial inputs are growing practices.

[55]Ibid.